



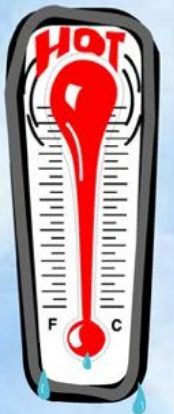
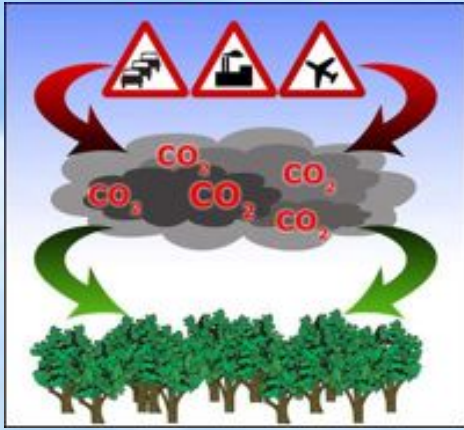
Energy, CO₂, Climate, and YOU!

Dr. Steve
(Doctor of Chemistry)
Stephen E. Schwartz

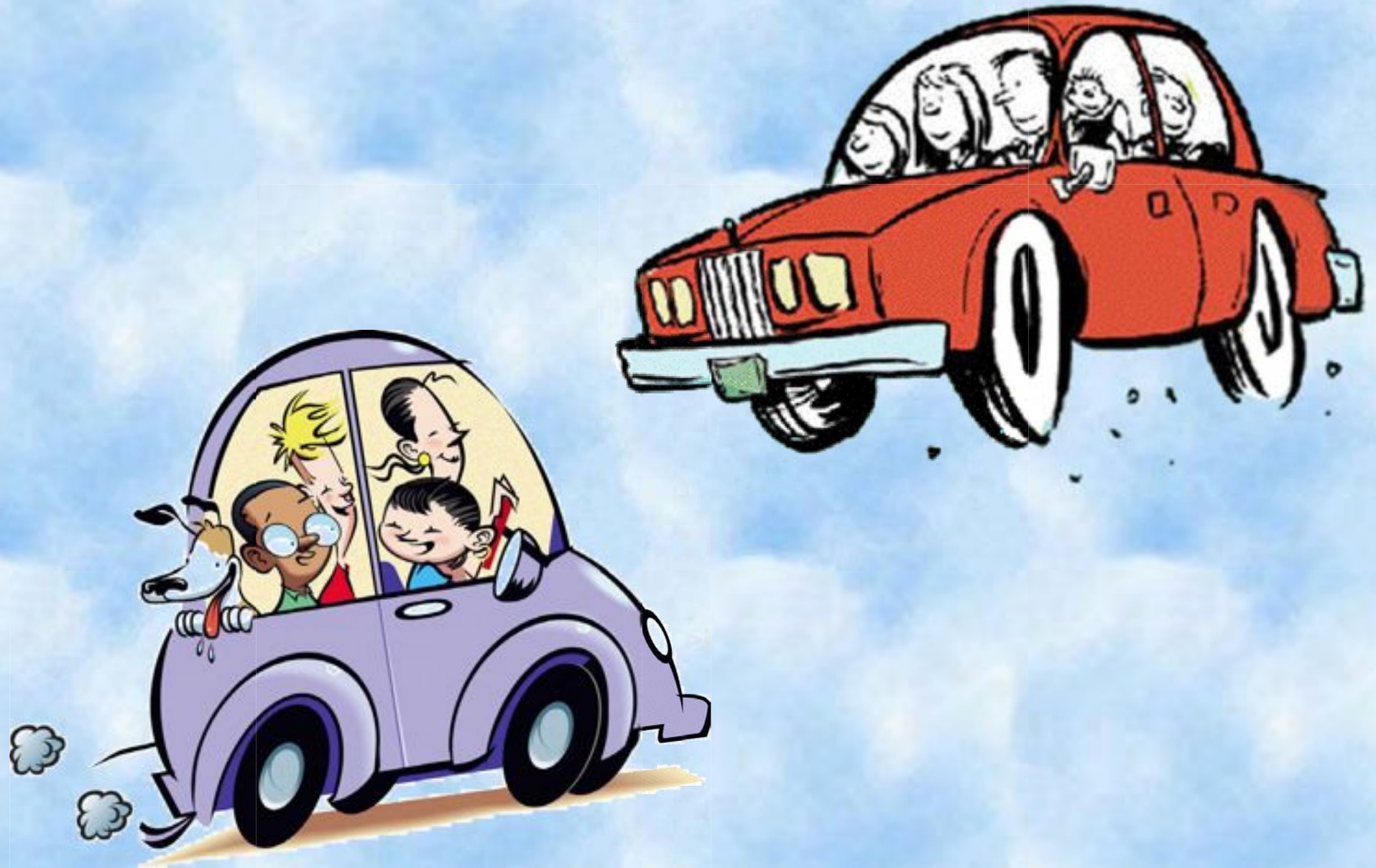
BROOKHAVEN
NATIONAL LABORATORY

summer  sundays

www.ecd.bnl.gov/steve



CARPOOLING TO SUMMER SUNDAY AT BNL



THE MOST EFFECTIVE WAY TO
DOUBLE THE FUEL ECONOMY
OF A CAR . . .

IS TO PUT TWO
PEOPLE IN IT!



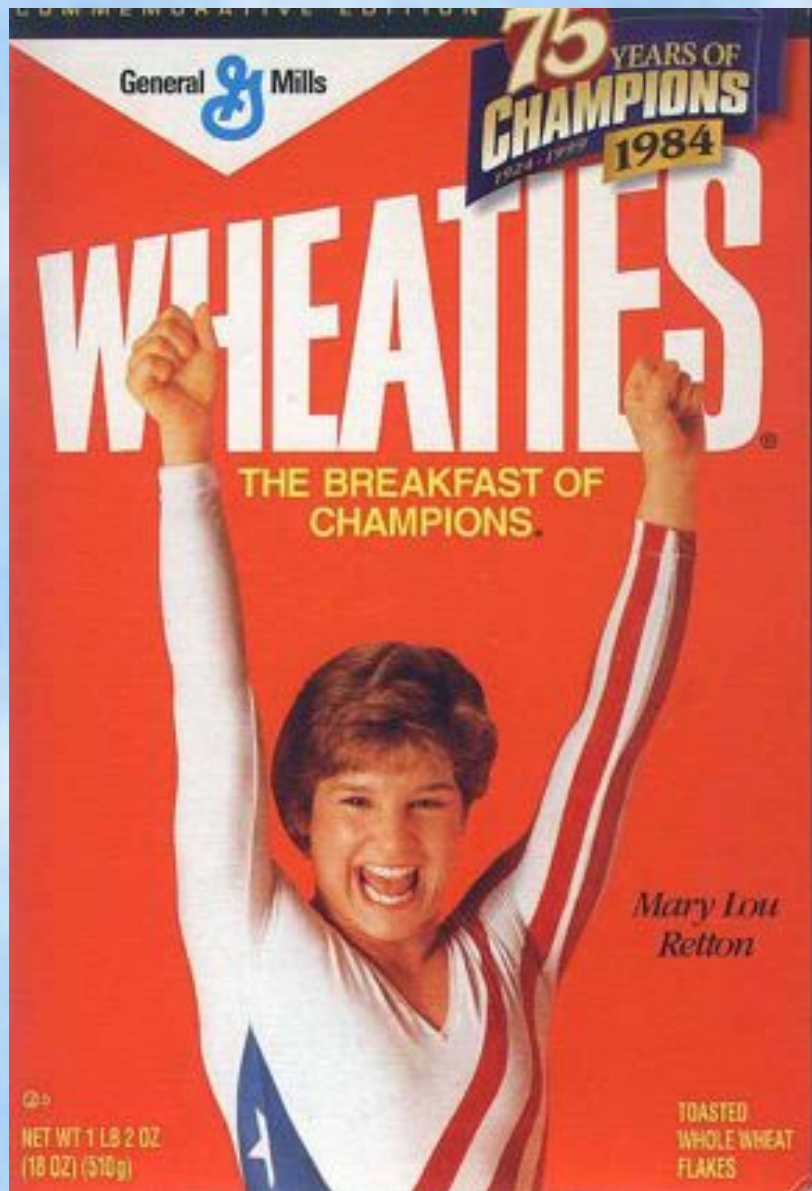
CARPOOLING CAN SAVE MORE THAN GAS



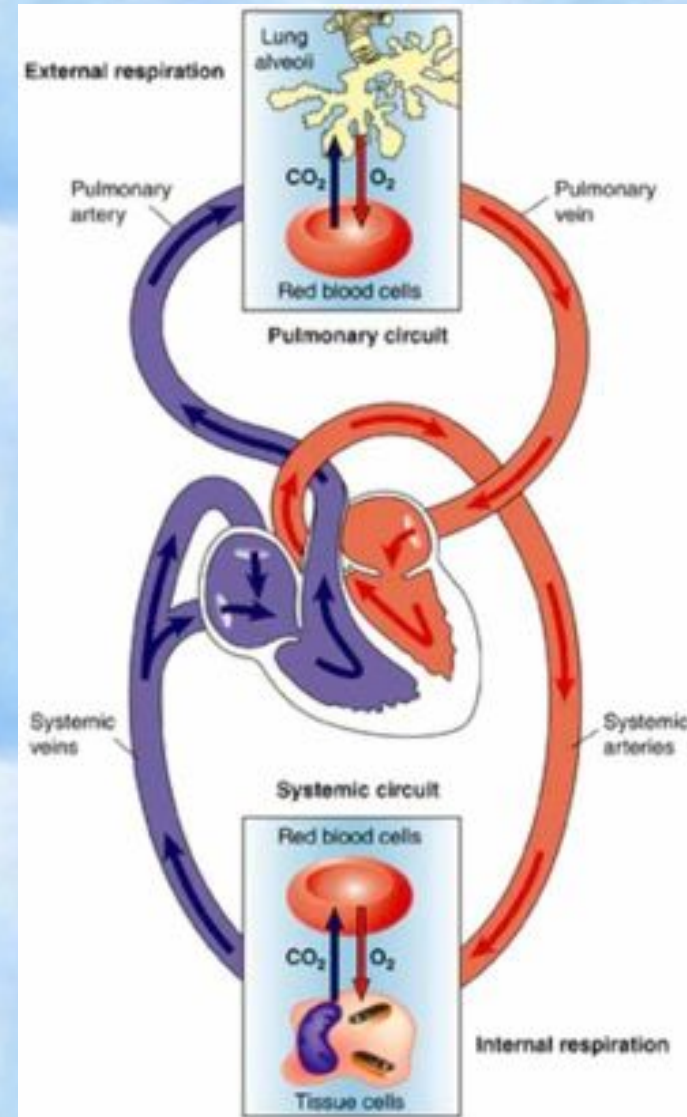
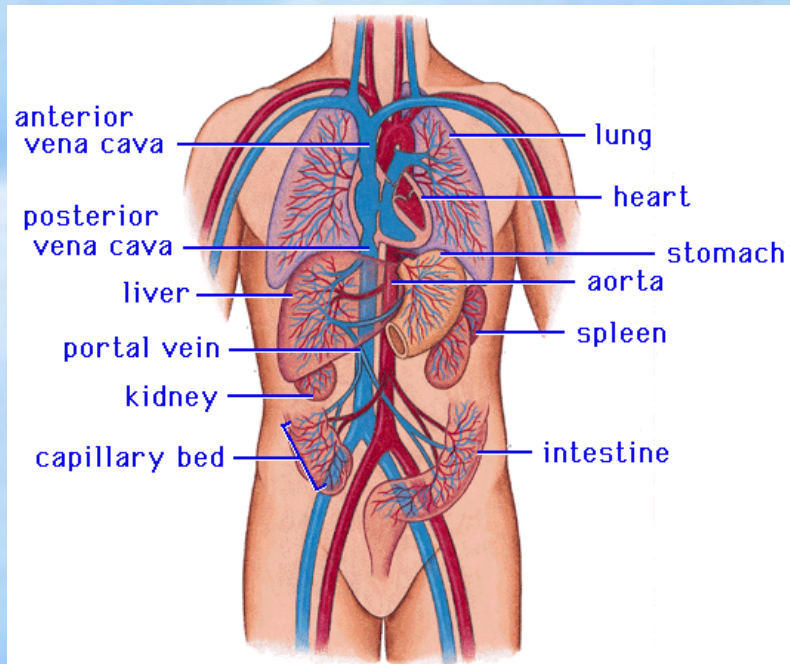
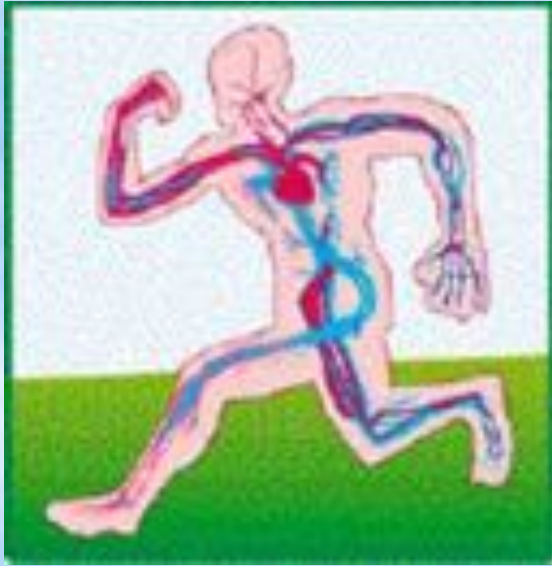


Energy

WHERE DO YOU GET YOUR ENERGY?



HOW DO ENERGY AND OXYGEN GET TO YOUR MUSCLES?

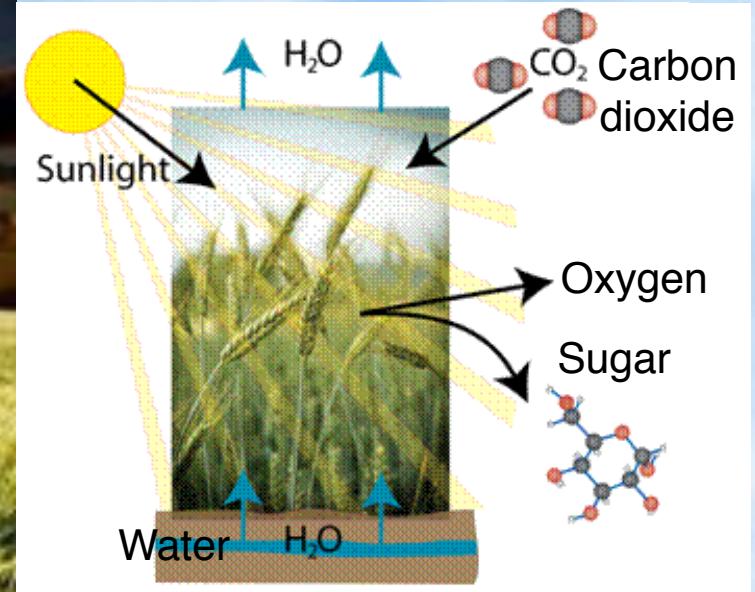


<http://www.prevent-stroke-and-heart-attack.com>

<http://library.thinkquest.org/5777/cir1.htm>

<http://newstt.com/how-is-circulatory-system-and-the-digestive-system-related/>

WHERE DOES YOUR FOOD GET ITS ENERGY?



www.ems.psu.edu/~pisupati/ACSO Outreach/Petroleum_1.html

www.desktopwallpaperhd.com

CALCULATE CALORIES PER GRAM



Nutrition Facts

Serving Size 1 serving (30 g)

Per Serving

Calories 90

Calories from Fat 0

Total Fat 0g

Sodium 80mg

Potassium 5mg

Carbohydrates 70g

Sugars 53.3g

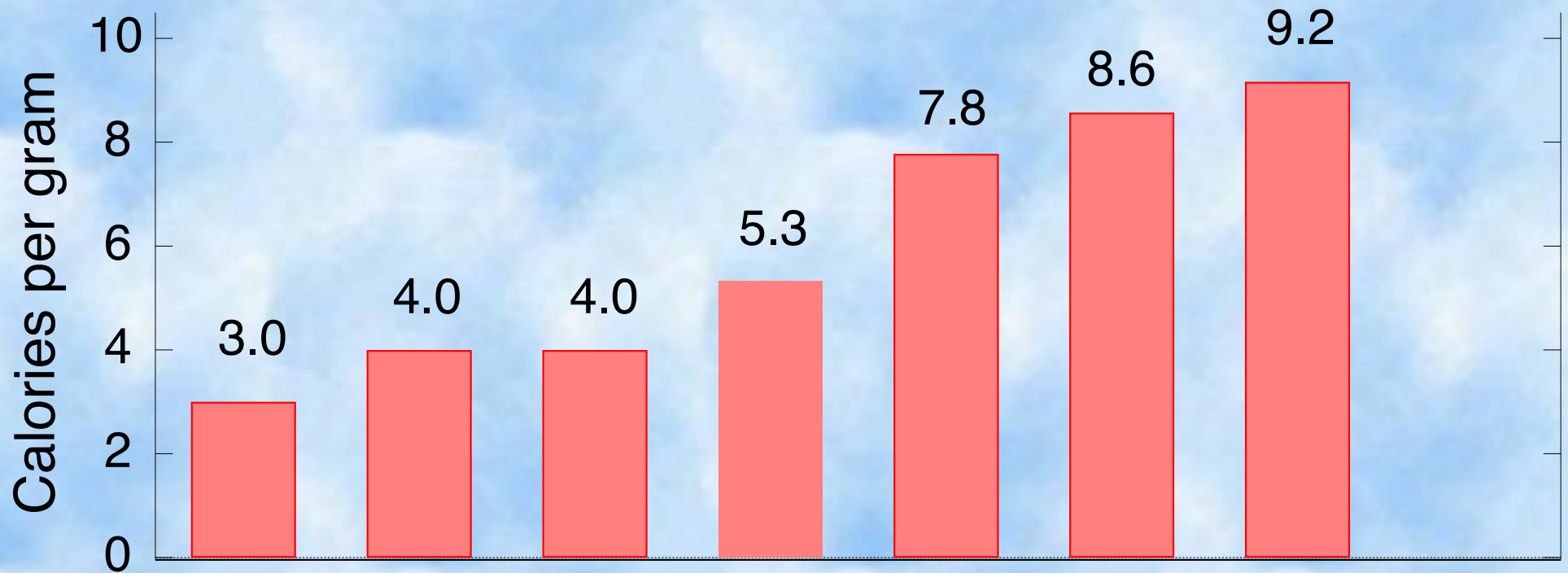
Protein 3.3g

90 Calories in 30 grams
(about 1 ounce)

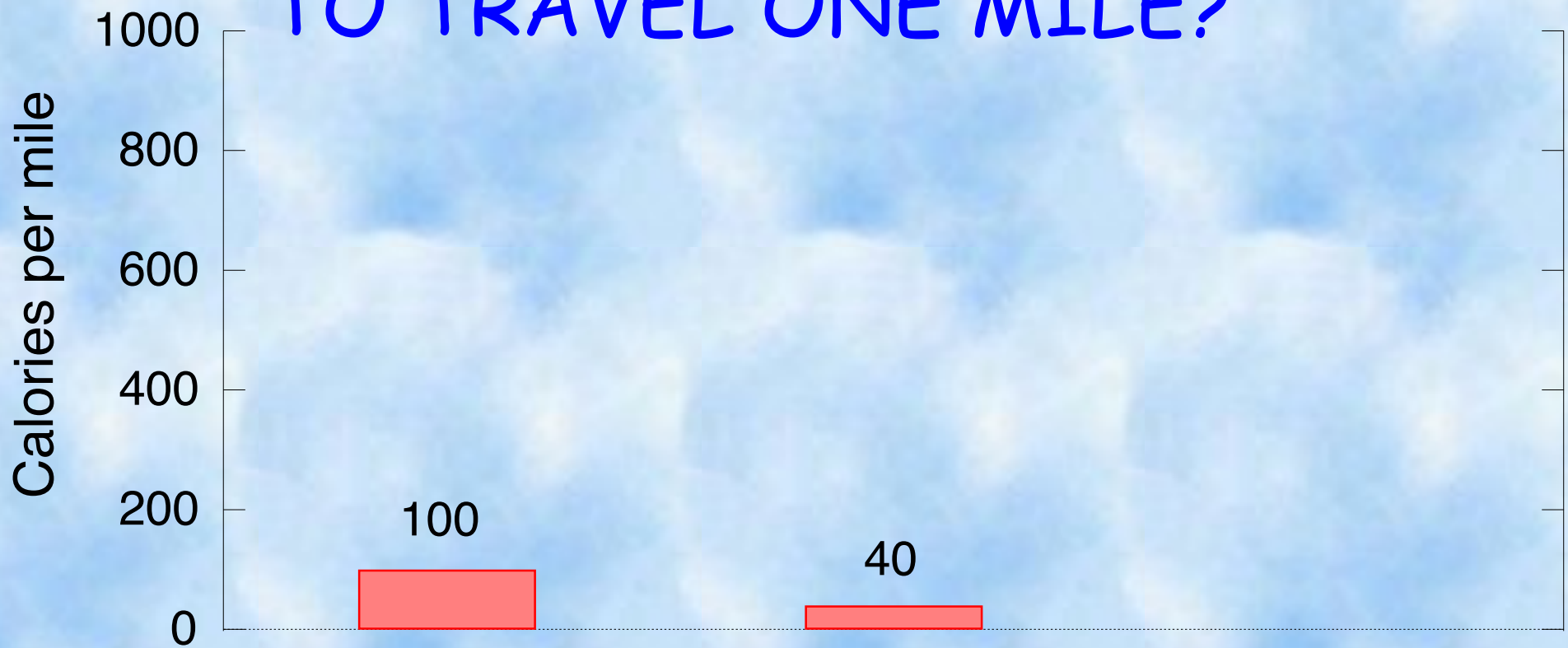
$$90 \div 30 = 3$$

3 Calories in one gram
(3 Calories per gram)

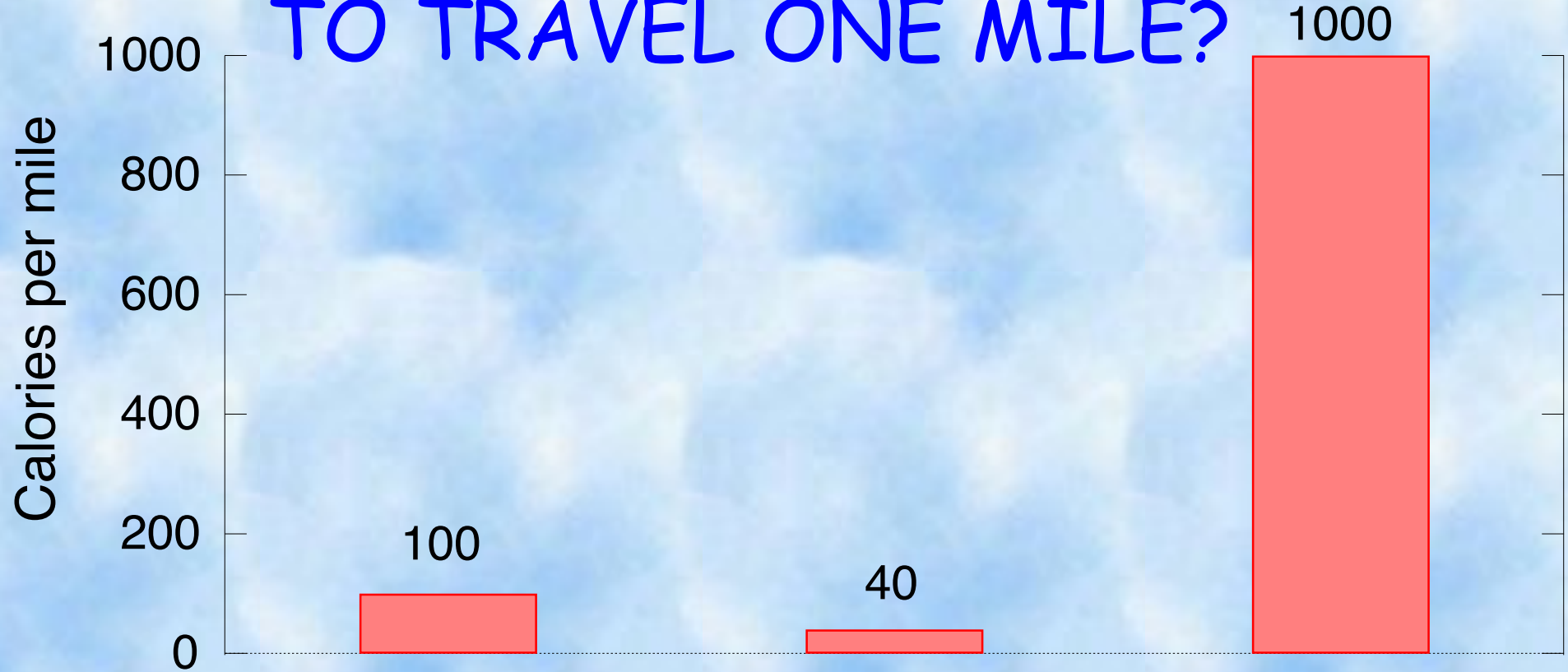
CALORIE CONTENT OF ENERGY FOODS



HOW MUCH ENERGY DOES IT TAKE TO TRAVEL ONE MILE?



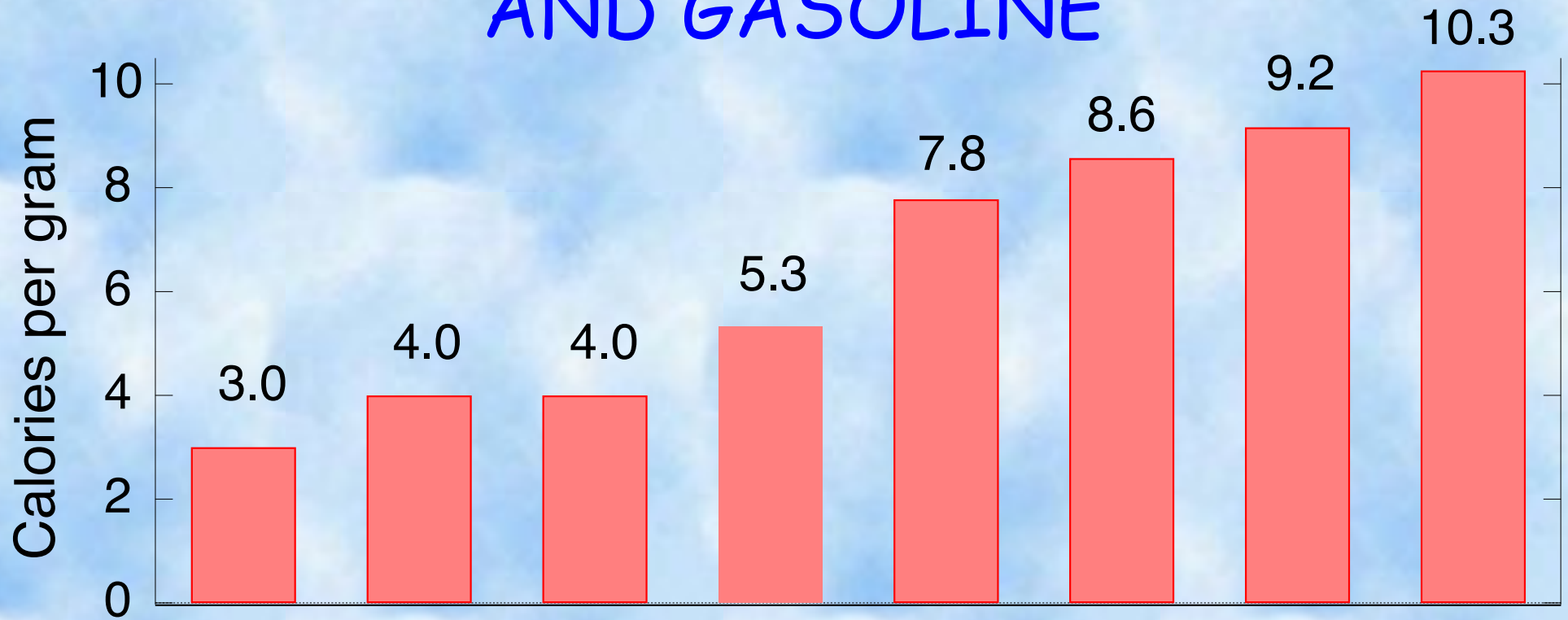
HOW MUCH ENERGY DOES IT TAKE TO TRAVEL ONE MILE?



WHERE DOES YOUR CAR GET *ITS* ENERGY?

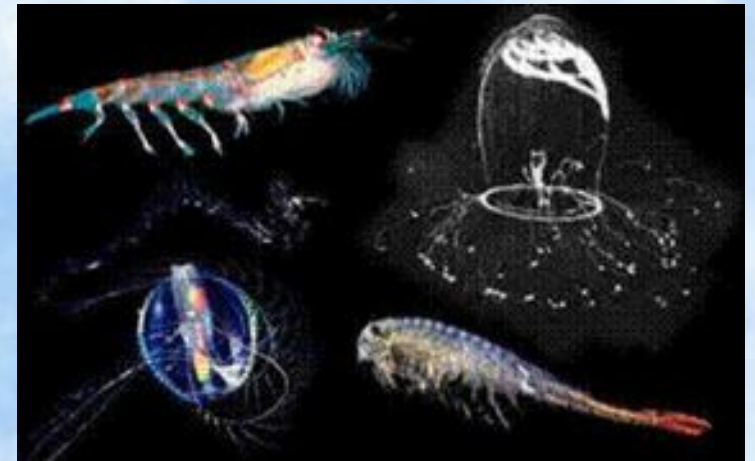
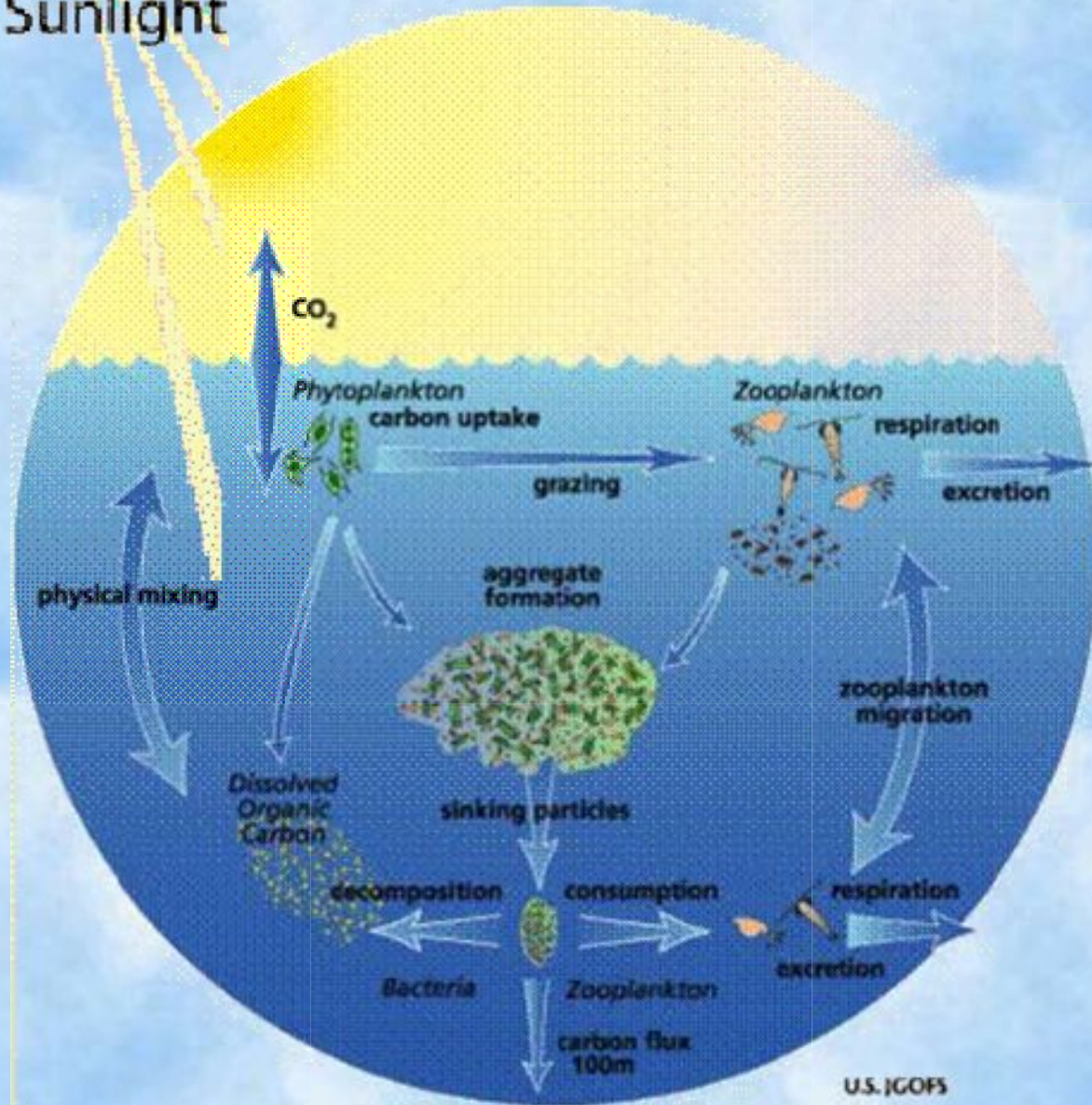


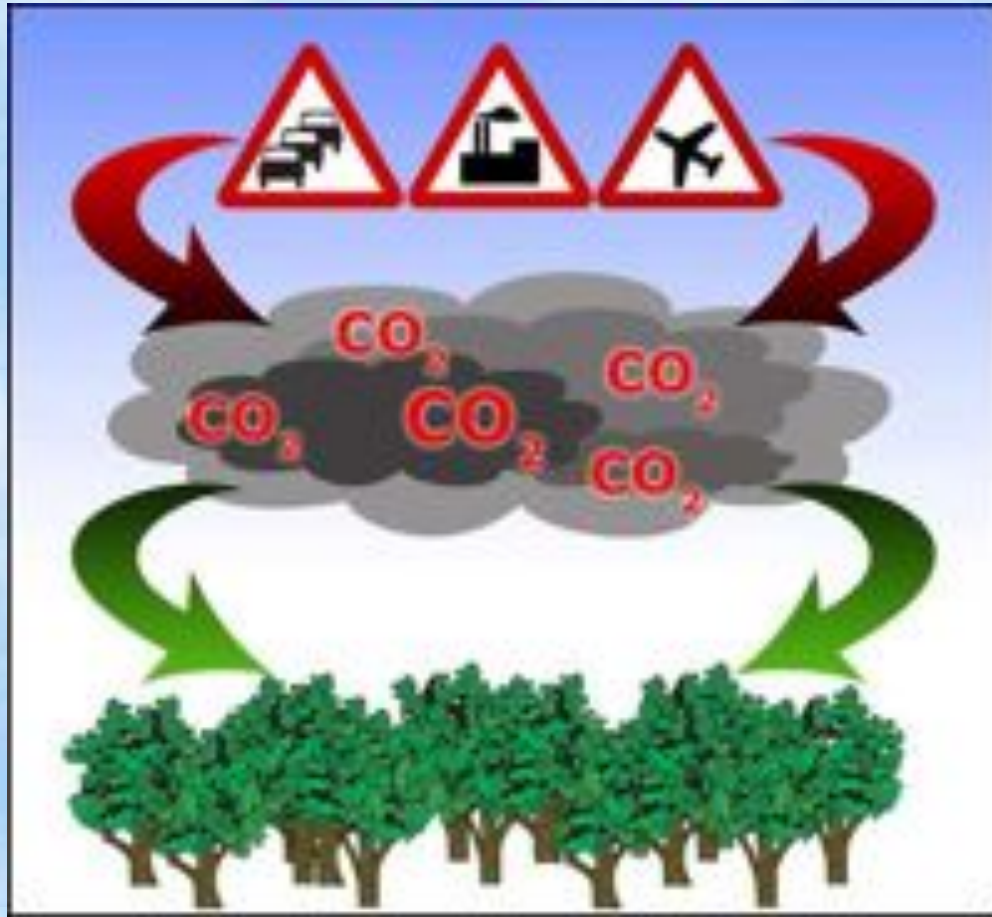
CALORIE CONTENT OF ENERGY FOODS AND GASOLINE



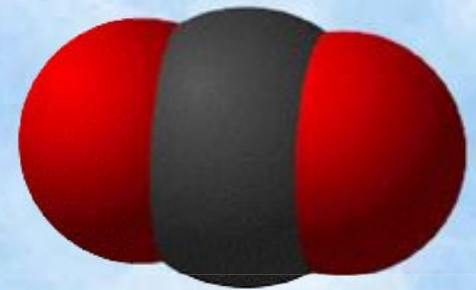


WHERE DOES GASOLINE GET ITS ENERGY?



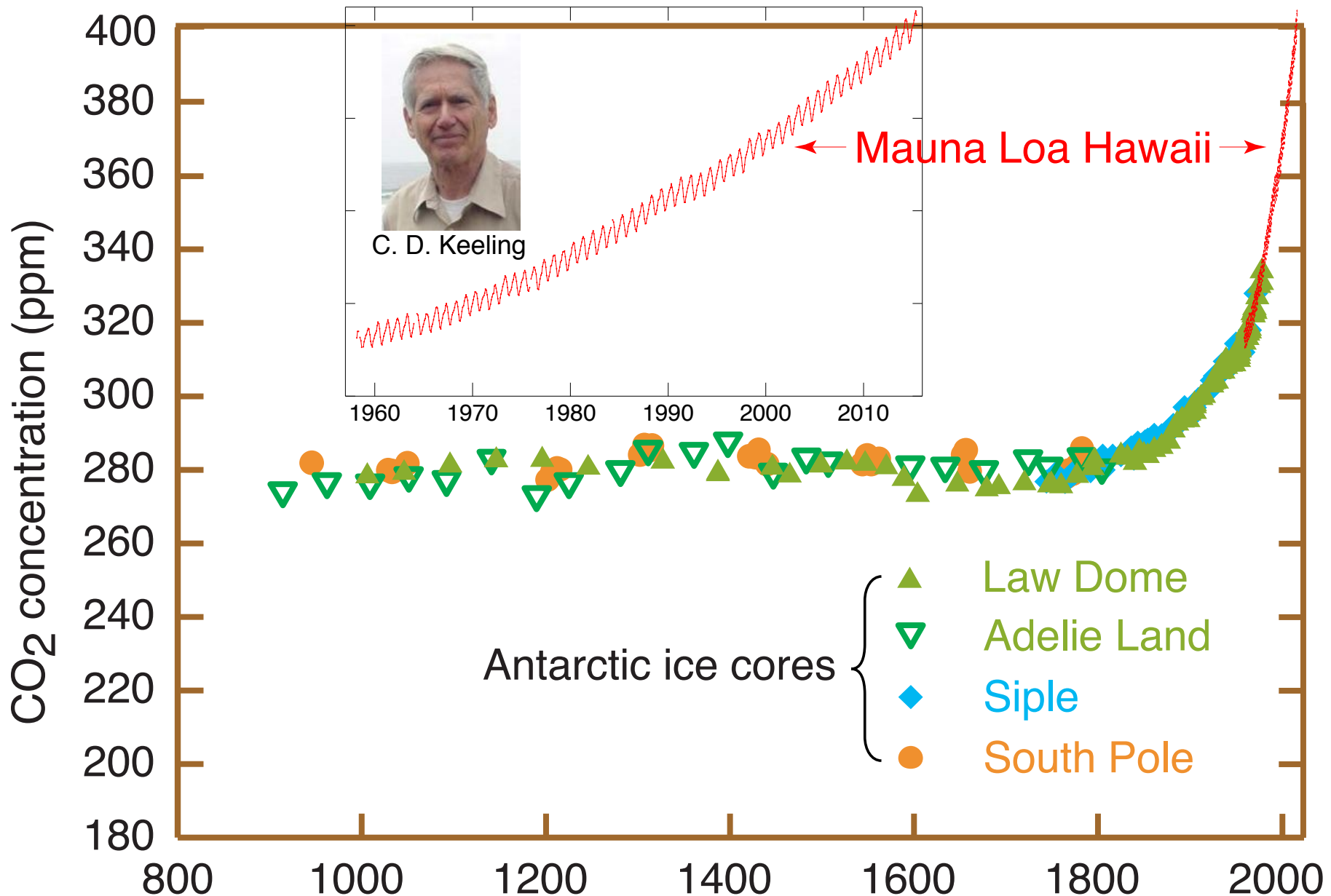


CO₂



Carbon Dioxide

ATMOSPHERIC CARBON DIOXIDE IS INCREASING



Global carbon dioxide concentration over the last thousand years

GLACIERS ARE OUR TIME MACHINE



New York Times, July 2, 2012

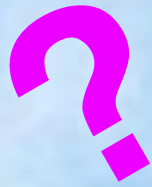
Lonnie Thompson, Ohio State University glaciologist, studies Earth's climate history by the ice archive.

***WHERE IS ALL
THIS CO₂
COMING FROM?***

***WHO IS
RESPONSIBLE?***



HOW MUCH CARBON IS IN A GALLON OF GASOLINE?



1 lb?

2 lbs?

3 lbs!?



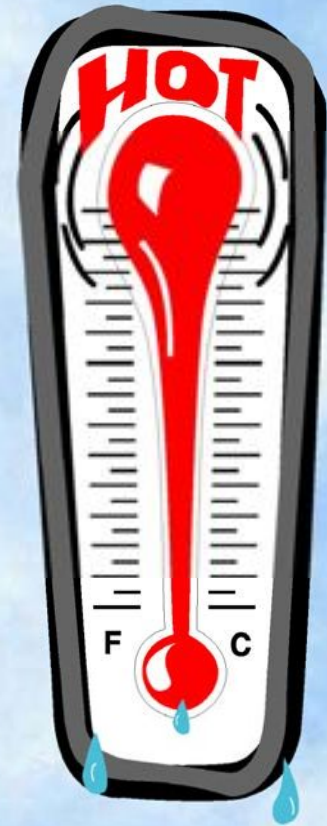
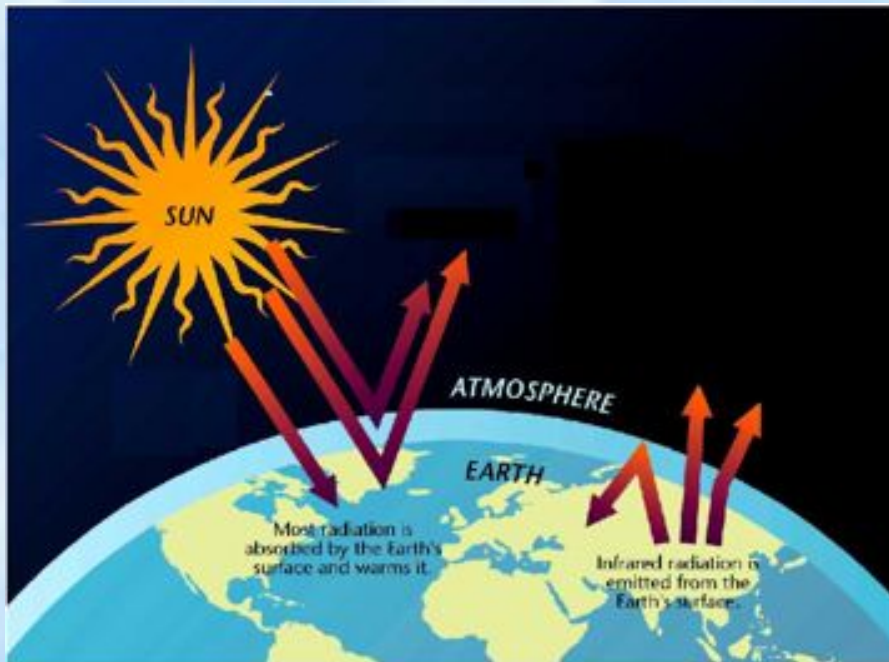
5 lbs!?!?



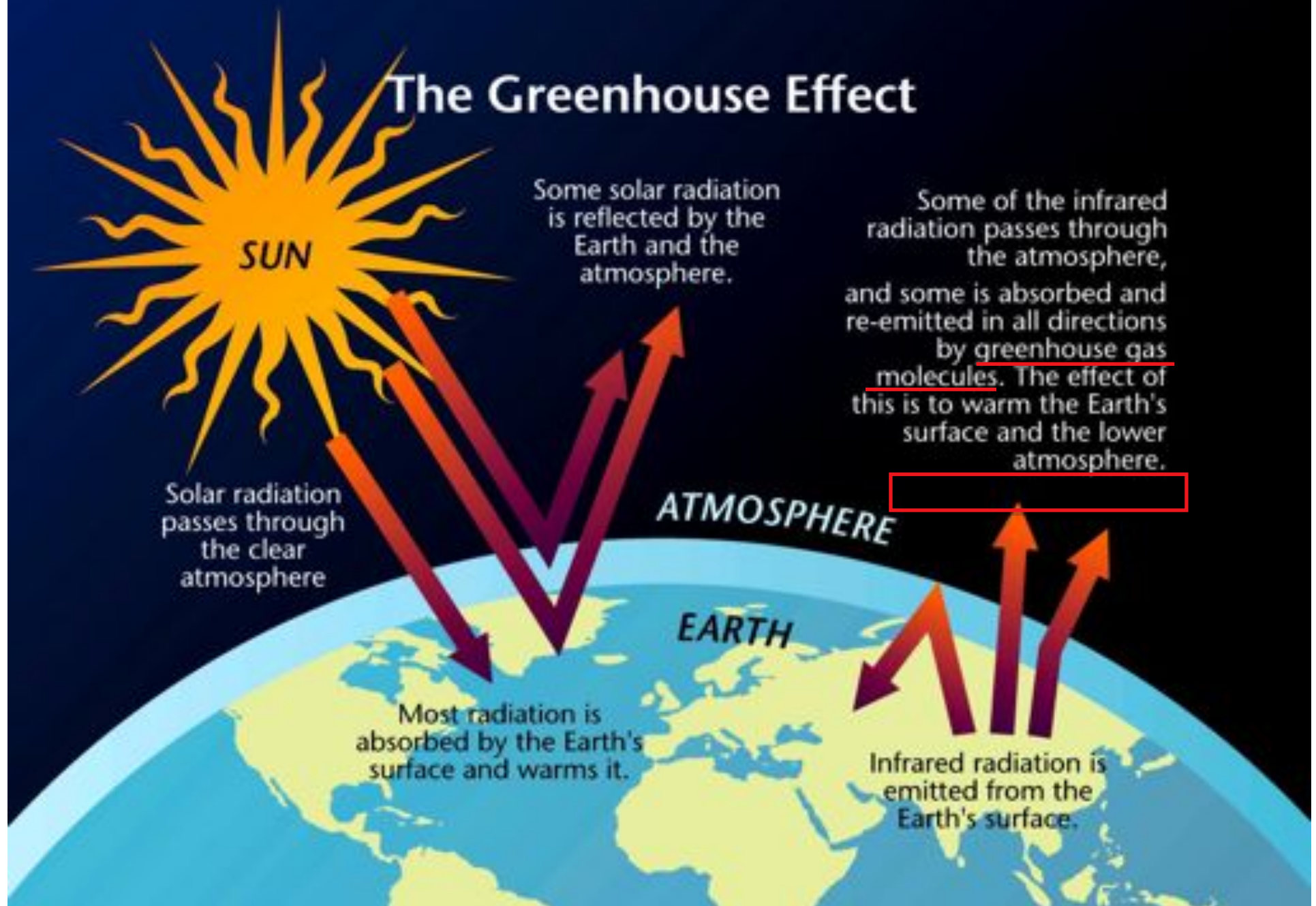
All of this carbon goes into the
atmosphere as carbon dioxide when
you burn the gasoline in your car.



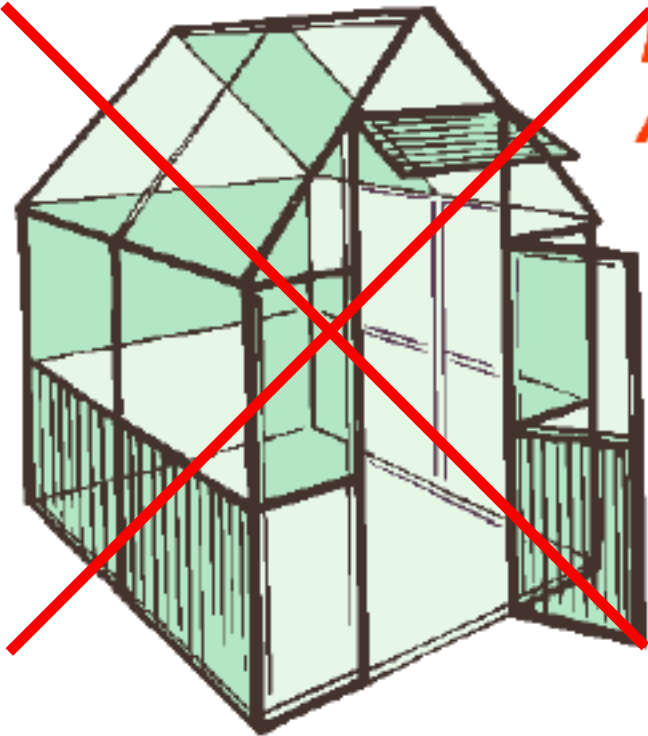
Climate



The Greenhouse Effect



THE GREENHOUSE EFFECT



EARTH'S ENERGY BUDGET: A DELICATE BALANCE

- Sunlight heats the Earth.
- The warm Earth radiates energy (in the form of infrared radiation, or heat) back out to space.
- Some of this infrared radiation is trapped in the atmosphere, giving Earth its temperate climate.

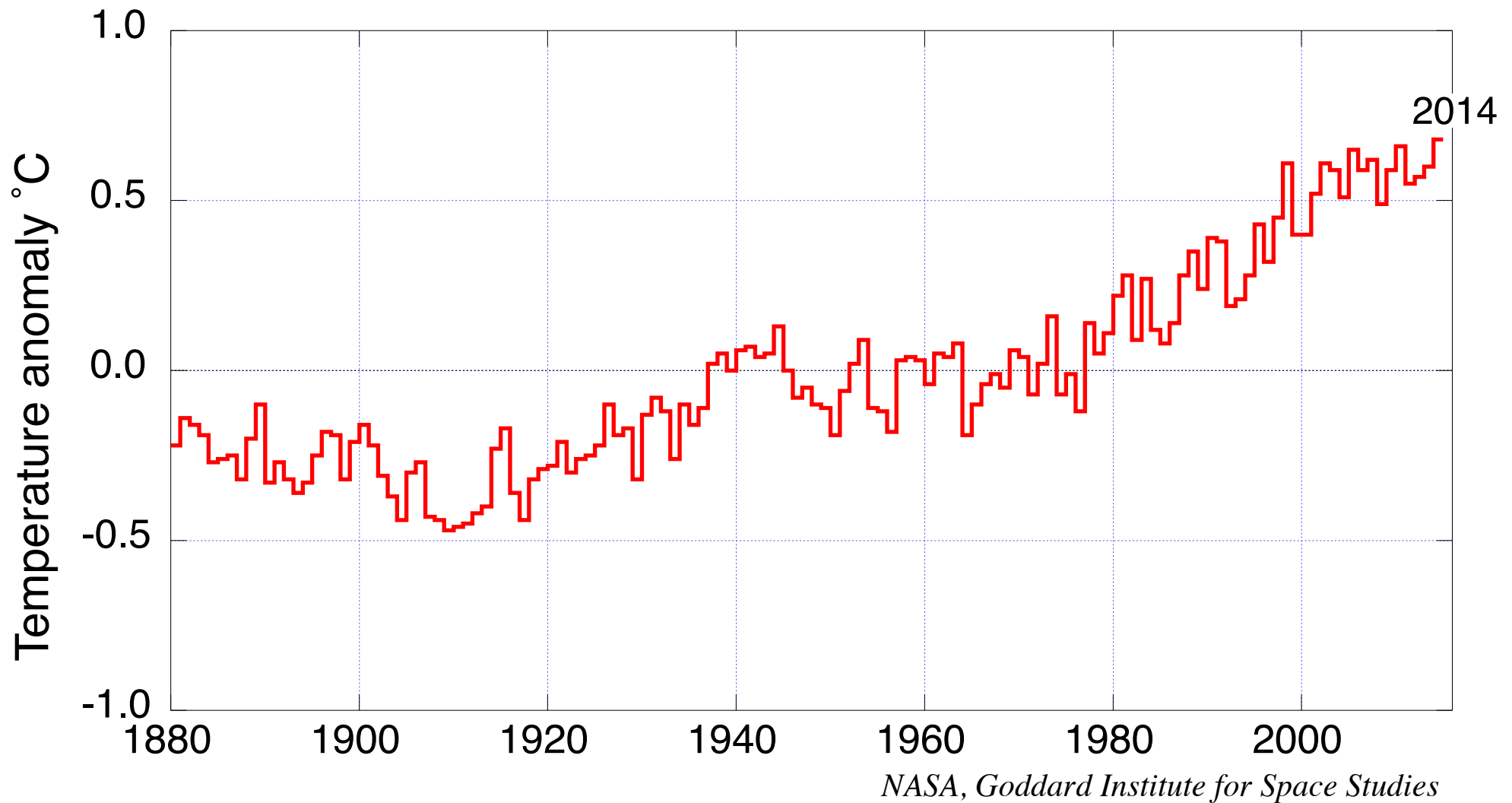
This is the greenhouse effect.

Global average temperature 15°C or 59°F

Without it, the Earth's climate would be like the moon's, harsh and severe.

Global average temperature -19°C or -2 °F

GLOBAL TEMPERATURE CHANGE SINCE 1880

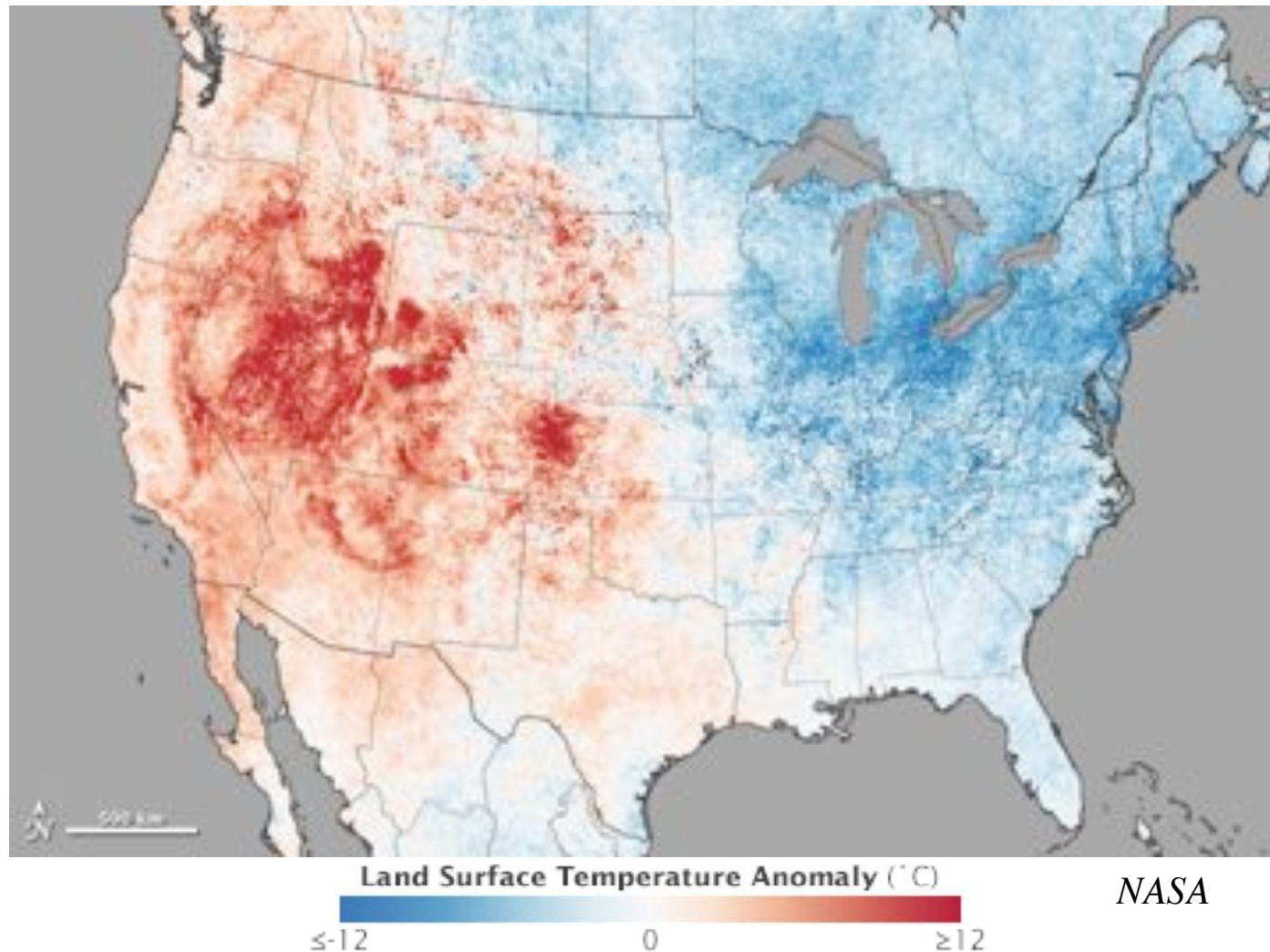


2014 was the hottest year on record.

14 of the hottest 15 years have been since 2000.

SATELLITE MEASURED TEMPERATURE ANOMALY

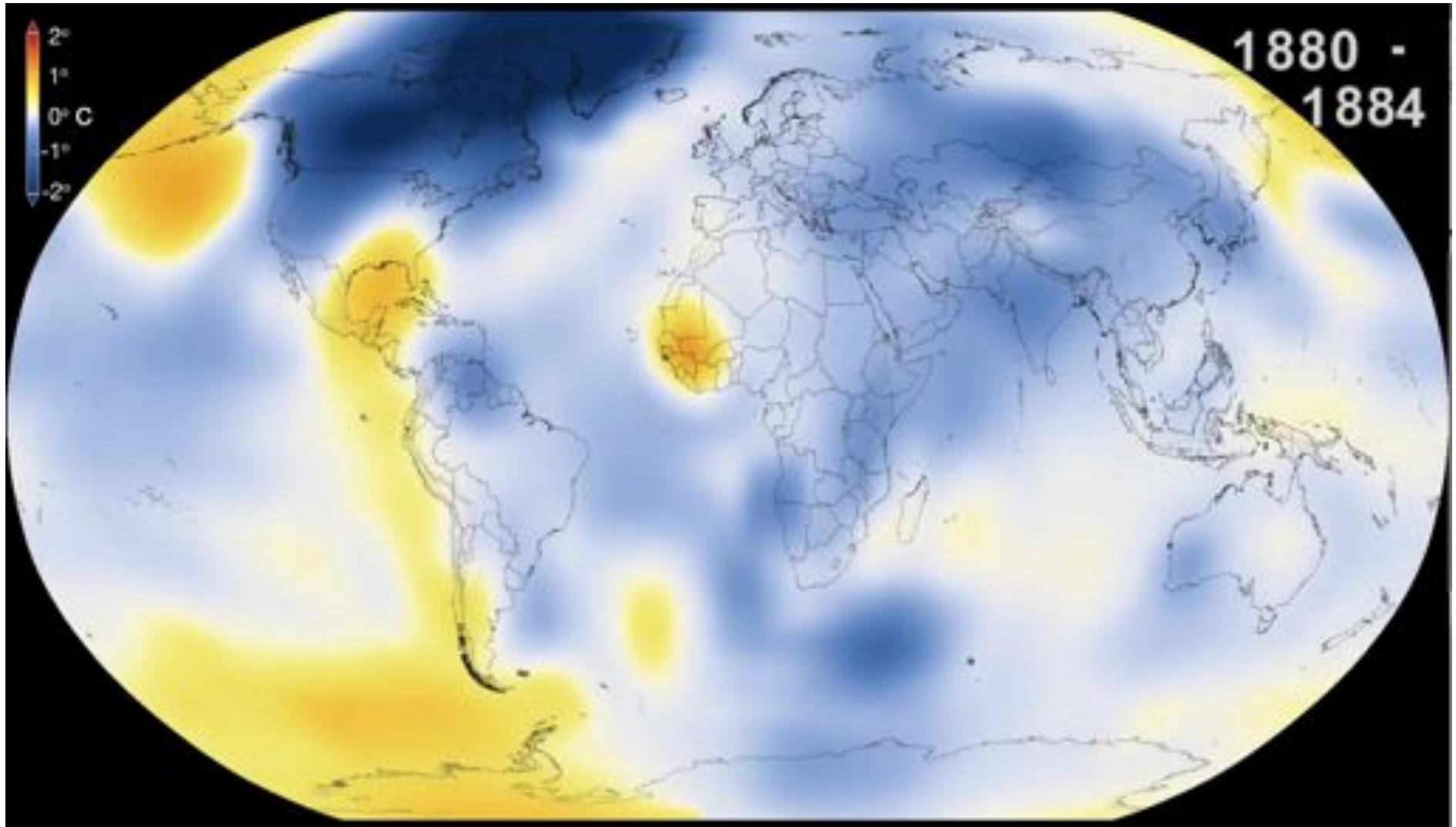
Continental U.S., February, 2015



Don't be misled by local temperatures!

THE WARMING PLANET

Five-Year-Average Temperature Anomalies Relative to Mid 20th Century



NASA Goddard Institute for Space Studies

GLACIERS

A RECORD OF CHANGE

PASTERZE GLACIER, AUSTRIA 1875 - 2004



About 2 km shorter.

Terminus replaced by artificial lake.

Decrease in length about 15 meters per year.

In 2003, decrease was 30 m in length and 6.5 m in thickness.

GRINNELL GLACIER

GLACIER NATIONAL PARK 1911 - 2000



MUIR GLACIER - MUIR INLET GLACIER BAY NATIONAL PARK, ALASKA 1941 vs. 2004



Muir Glacier, William O. Field on 13 August 1941 and by Bruce F. Molnia on 31 August 2004

UPSALA GLACIER, ANDES, ARGENTINA

1928



2004



www.time.com

RHONE GLACIER, VALAIS, SWITZERLAND

1859 - 2001



Glacial retreat is 2.5 km.

Base is 450 meters higher.



THE NEW NORMAL?



THE NEW NORMAL?

Colorado Springs, June, 2013



Are spring wildfires the new normal?

THE NEW NORMAL?

Colorado Springs, June, 2012



THE NEW NORMAL?

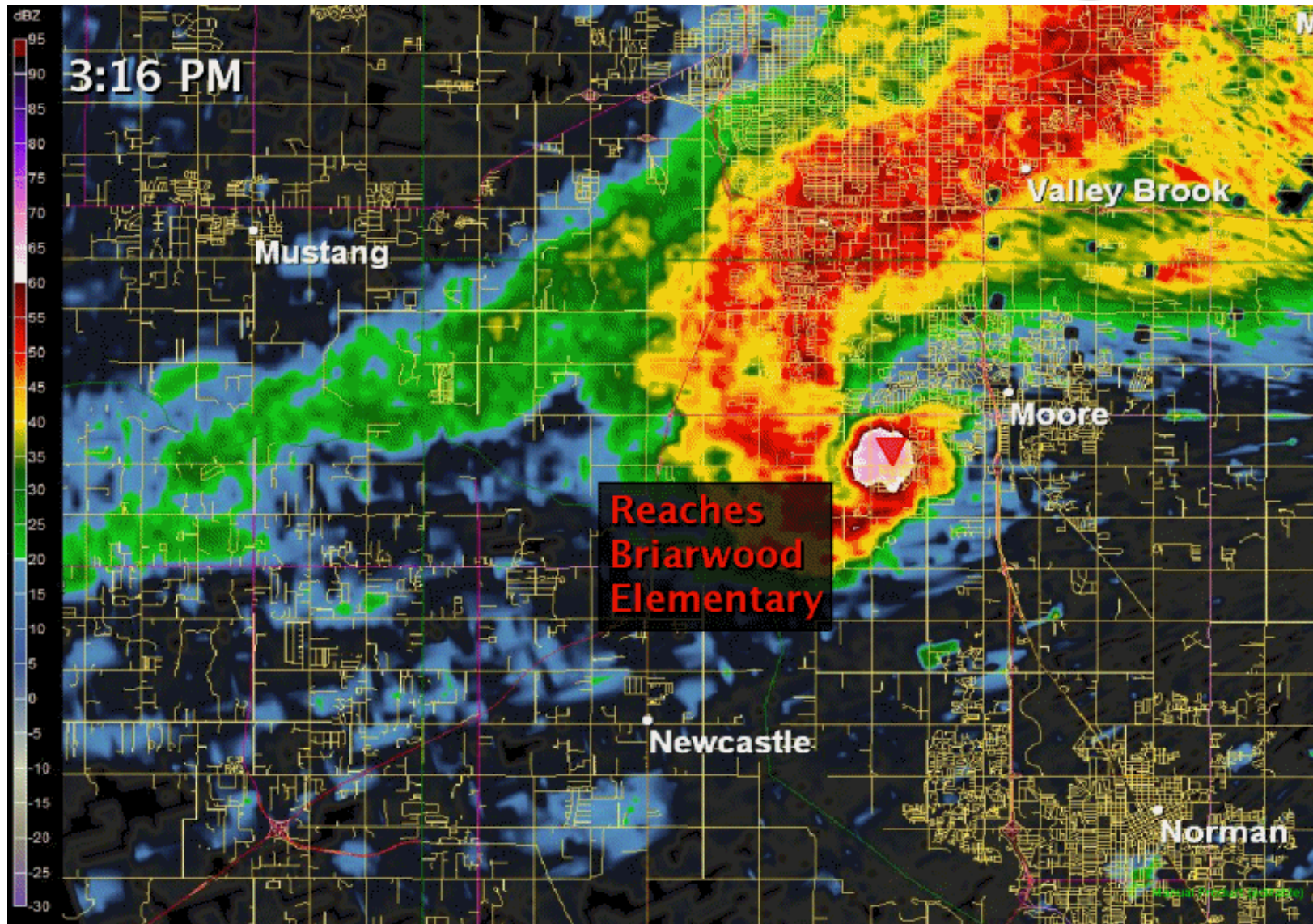
Tornado, Joplin, Missouri, May, 2011



Multiple-vortex EF5 tornado.

THE NEW NORMAL?

Tornado, Moore, Oklahoma, May, 2013



EF5 tornado kills 23, injures over 300.

THE NEW NORMAL?

Tornado, Moore, Oklahoma, May, 2013



THE NEW NORMAL?

Tornado, Moore, Oklahoma, May, 2013



THE NEW NORMAL?

Hutchinson, Kansas, July, 2015



THE NEW NORMAL?

Flat Gap, Kentucky, July, 2015



THE NEW NORMAL?

Flat Gap, Kentucky, July, 2015



THE NEW NORMAL?

Flat Gap, Kentucky, July, 2015



THE NEW NORMAL?

Flat Gap, Kentucky, July, 2015



THE NEW NORMAL?

Flat Gap, Kentucky, July, 2015



THE NEW NORMAL?

Huntington Lake, California, 2014



State Water Board adopted emergency water conservation regulations on Tuesday, July 15, which establishes individual temporary prohibitions like lawn-watering. Violations may be punishable by fines of up to \$500.

THE NEW NORMAL?

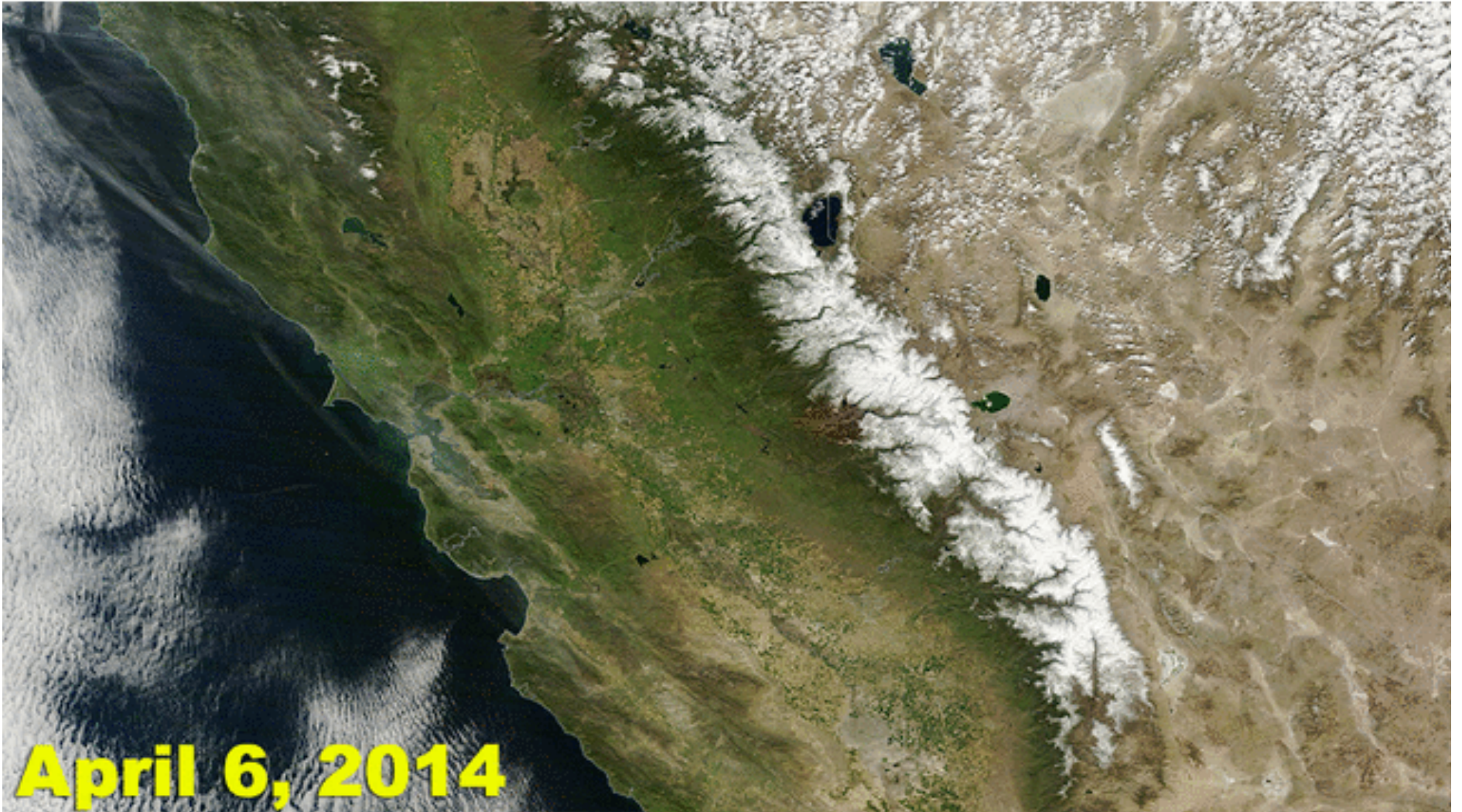
Lake McClure, California, April, 2015



Reservoir is at 11% of capacity.

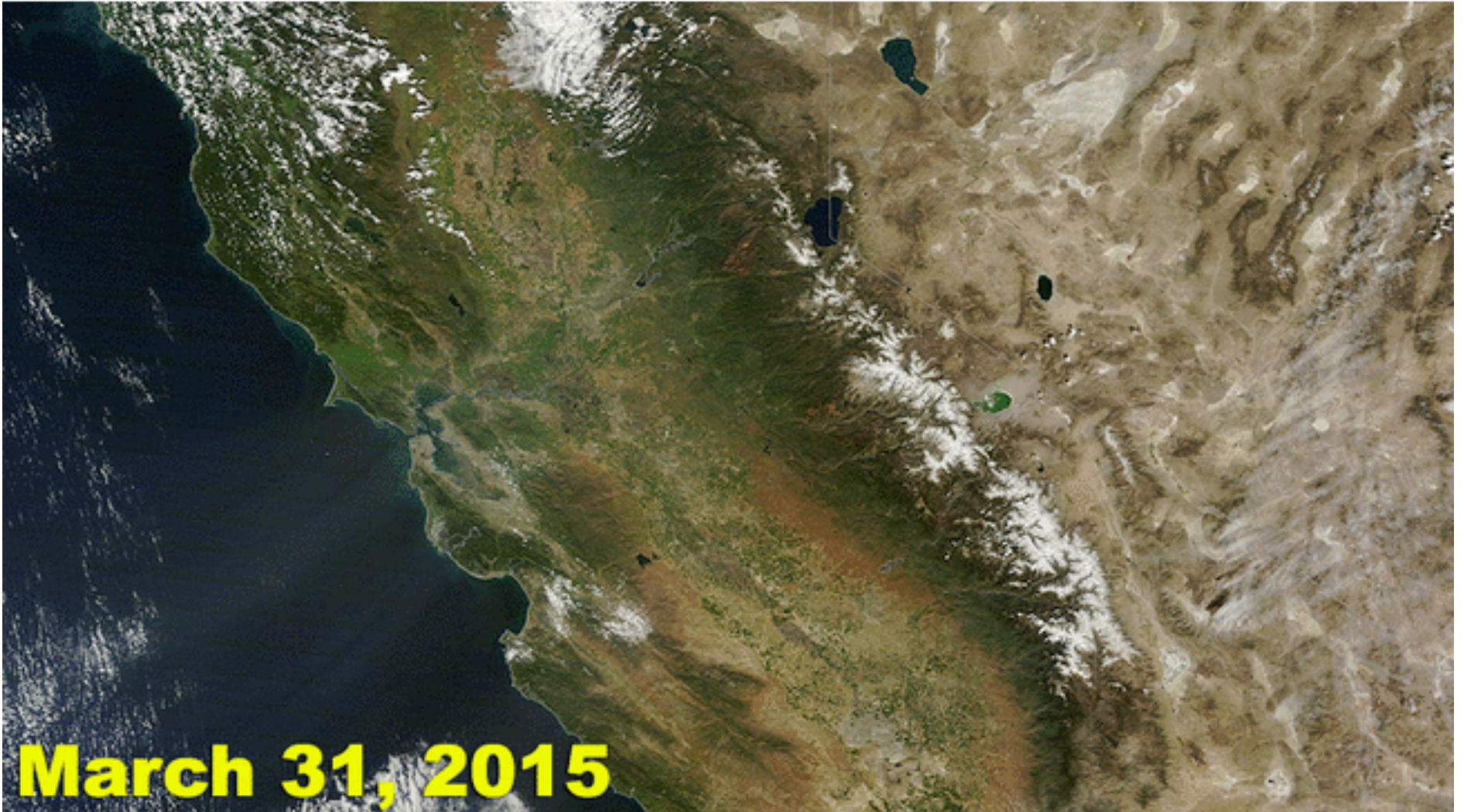
THE NEW NORMAL?

California Snowpack, 2014



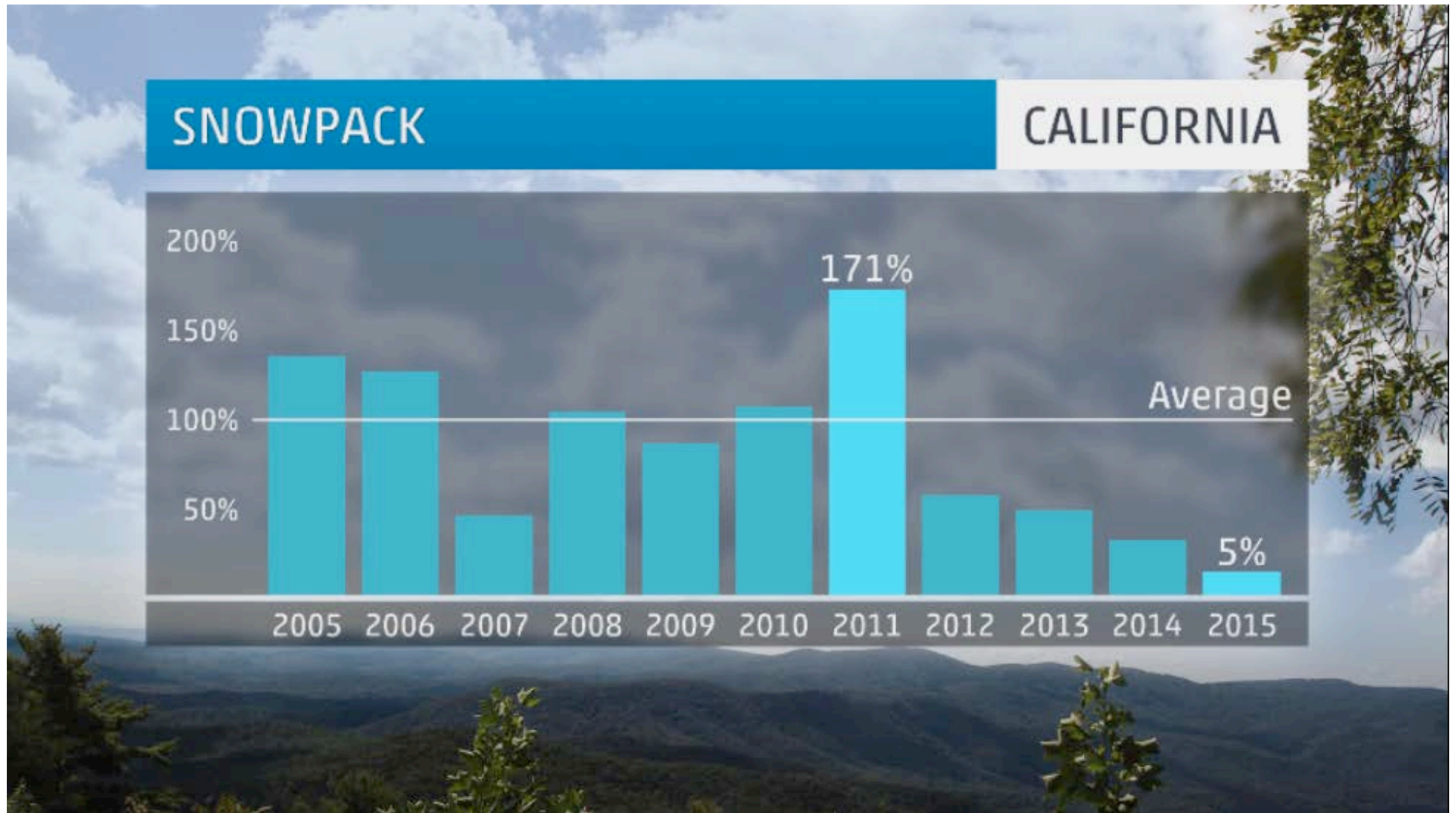
THE NEW NORMAL?

California Snowpack, 2015



THE NEW NORMAL?

2015 California snowpack was 5% of average.

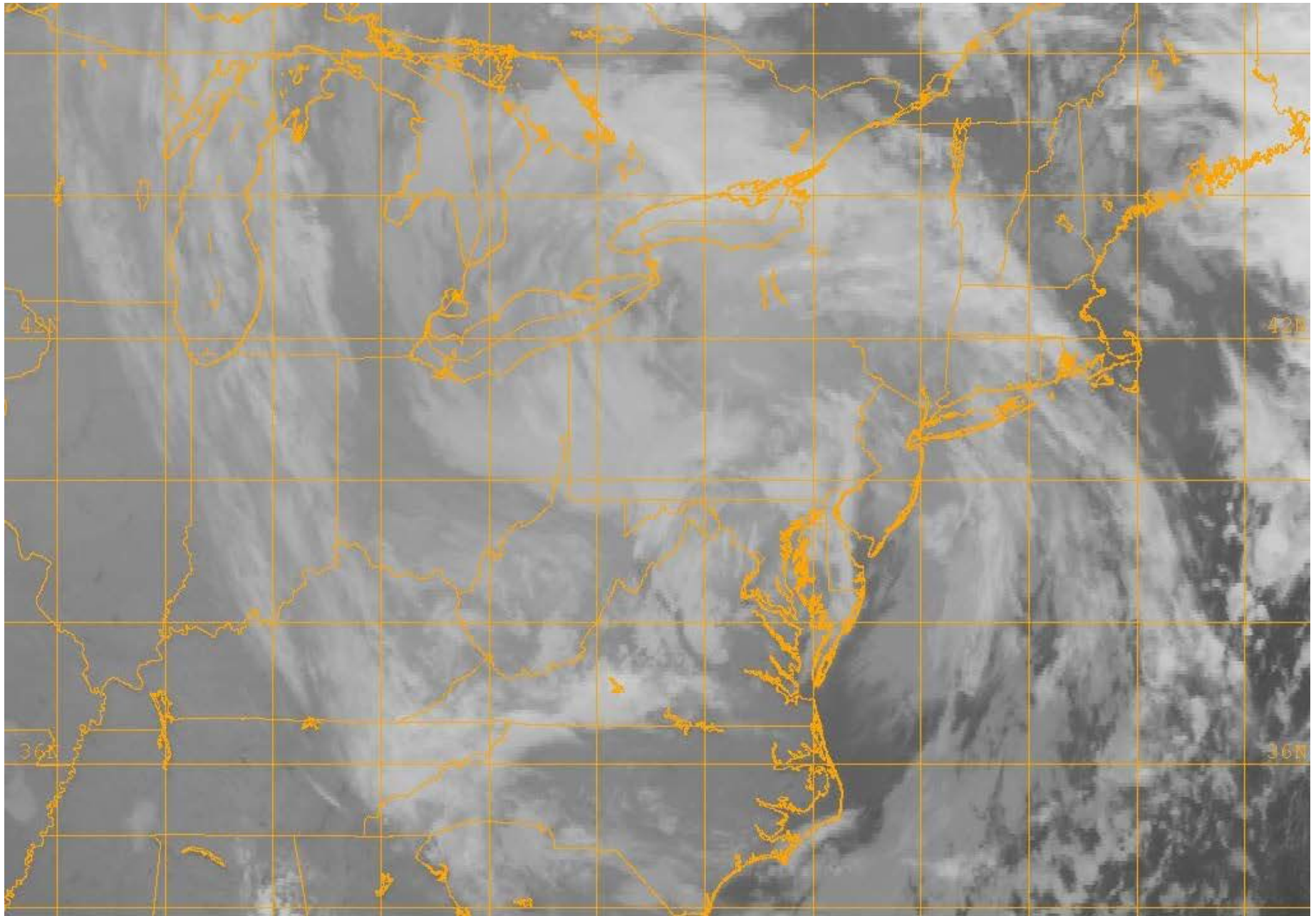


SUPERSTORM SANDY



THE NEW NORMAL?

SUPERSTORM SANDY – THE NEW NORMAL?



Sandy extended from Carolinas to Canada, Atlantic to Great Lakes

SUPERSTORM SANDY – THE NEW NORMAL?

Breezy Point, Queens, NYC



SUPERSTORM SANDY – THE NEW NORMAL?

Hoboken NJ



SUPERSTORM SANDY – THE NEW NORMAL?

Fenwick Island, DE



SUPERSTORM SANDY – THE NEW NORMAL?

Fort Lauderdale, FL



SUPERSTORM SANDY – THE NEW NORMAL?

Lake Erie, Near Cleveland OH



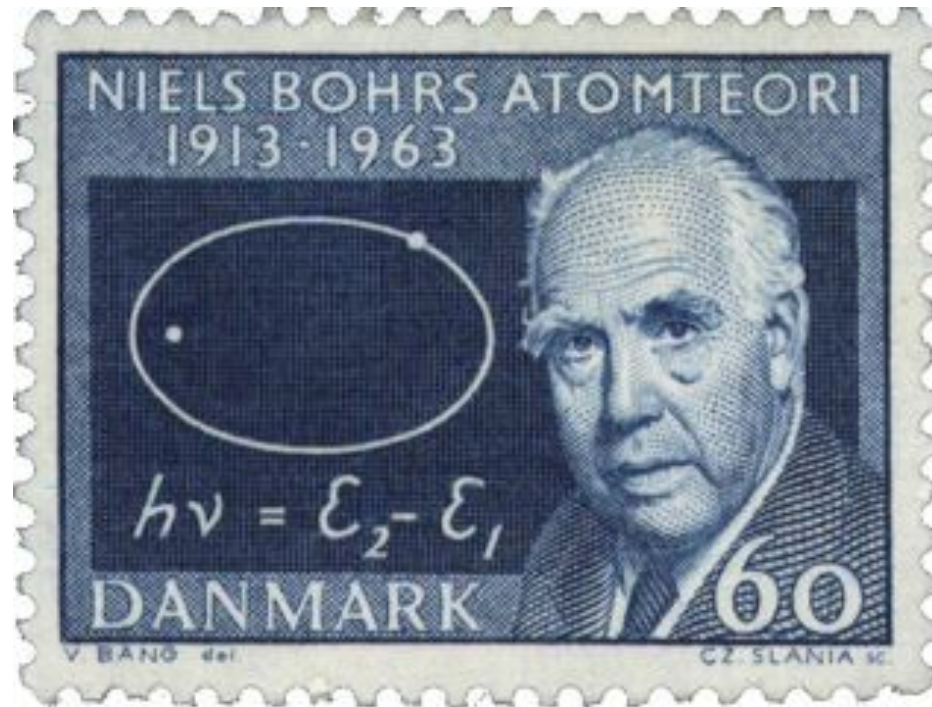
SANDY ON LONG ISLAND – THE NEW NORMAL?



*Looking to the
Future . . .*



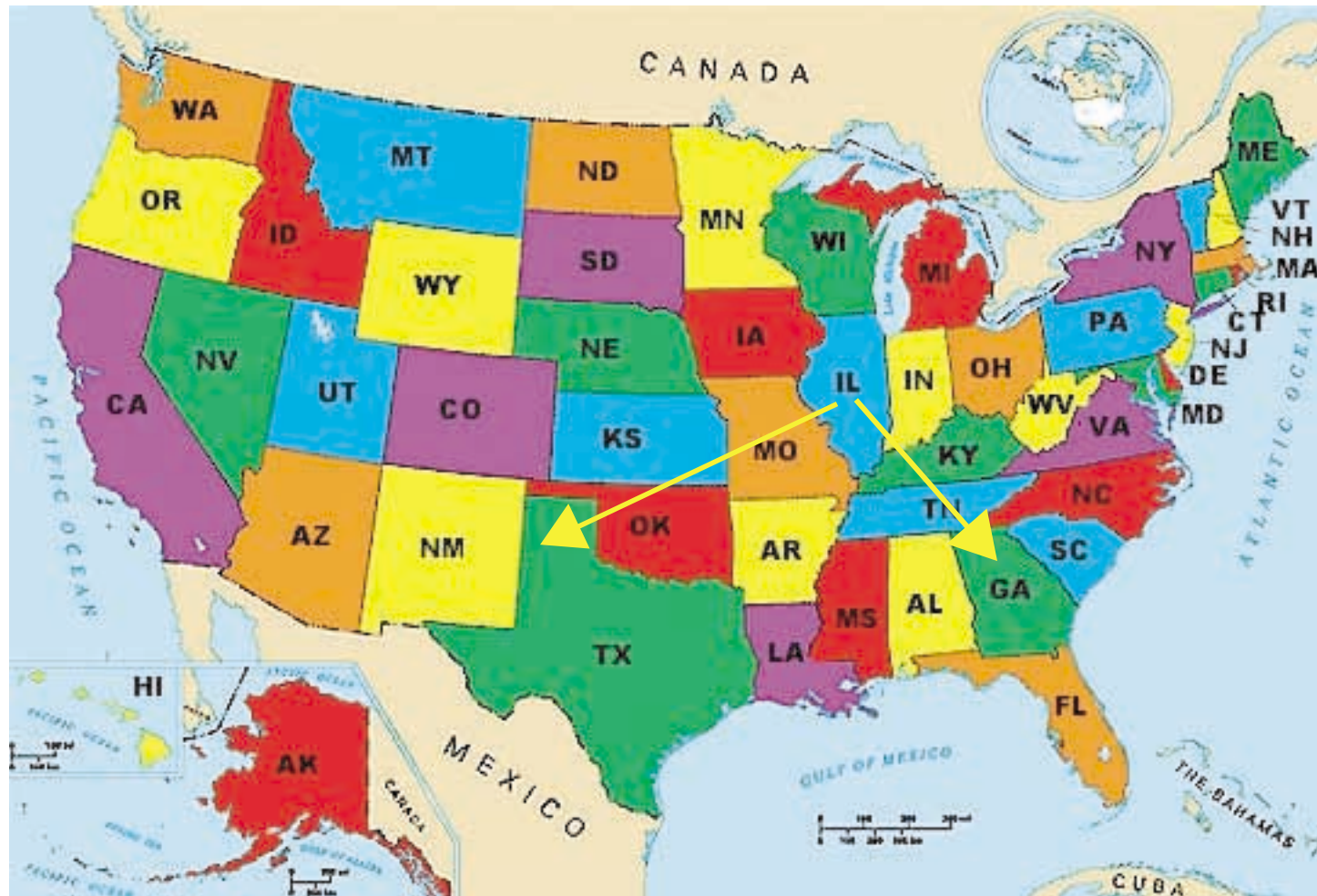
*Prediction is difficult,
especially about the future.*



– Niels Bohr

WHAT WILL BE THE FUTURE CLIMATE OF ILLINOIS?

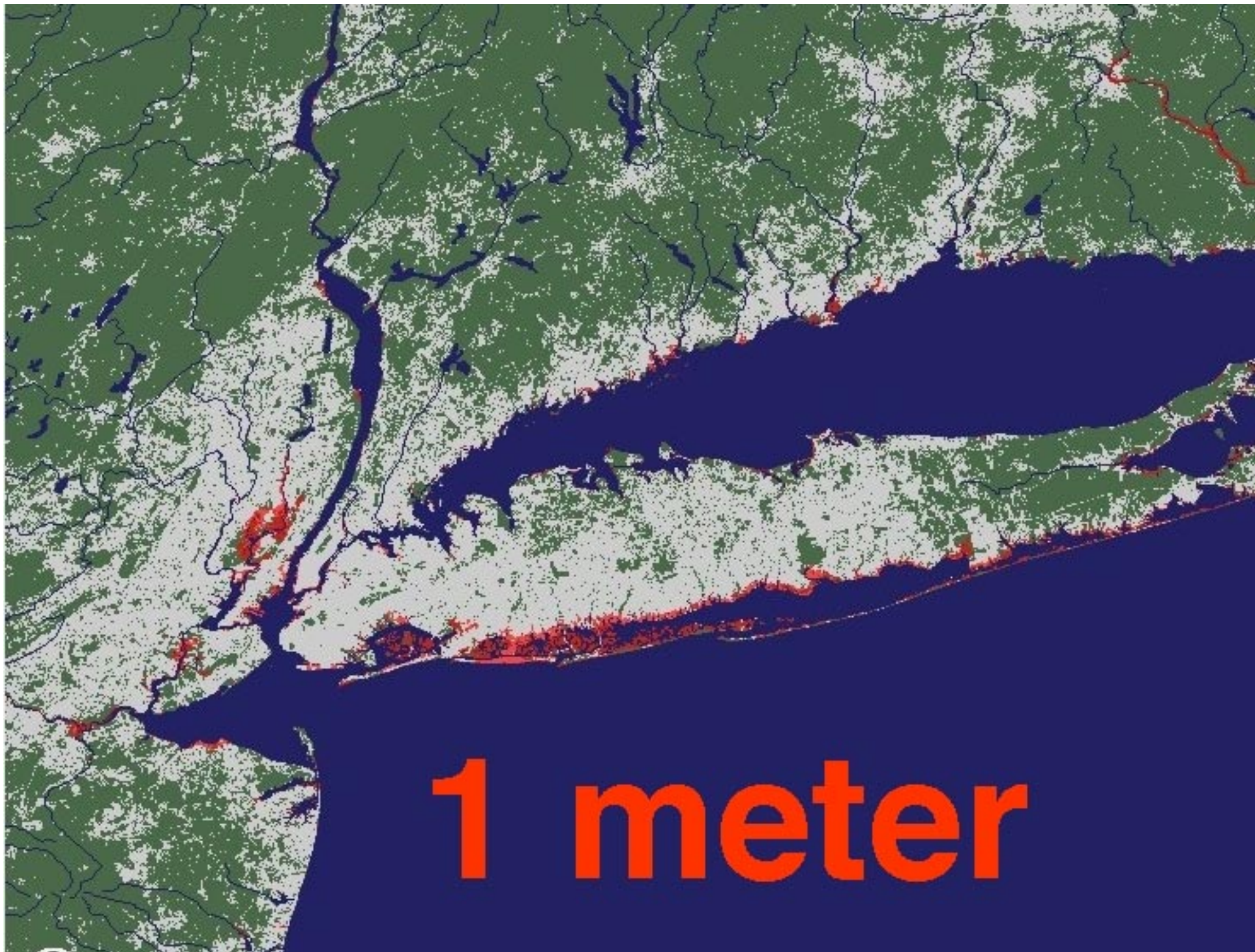
It will be as if you move Illinois 200 miles south.



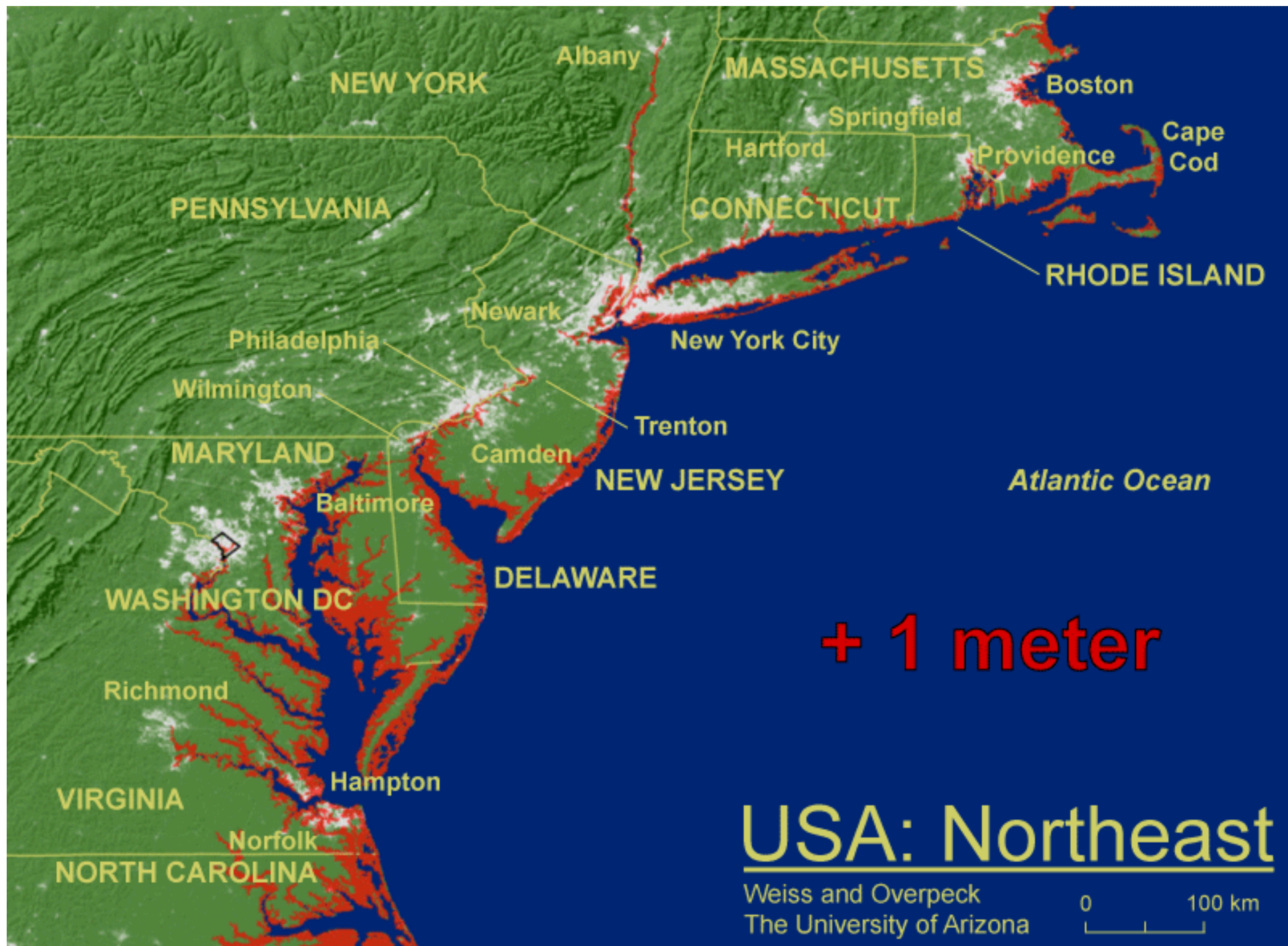
But we don't know if it will be moving to Georgia or the Texas panhandle.



present









*"Gentlemen, it's time we gave some serious thought
to the effects of global warming."*

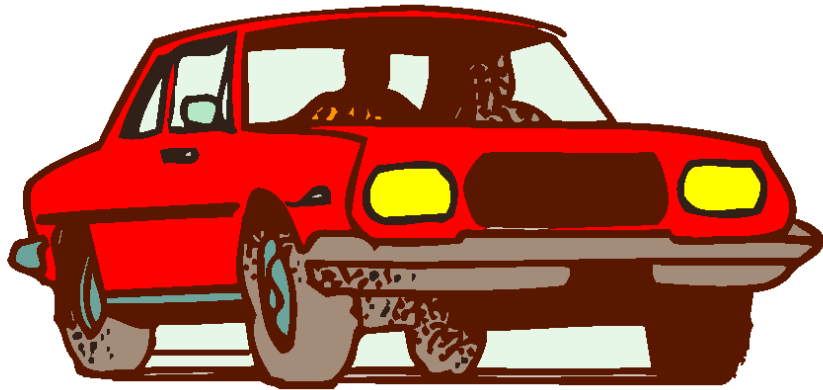


you!

IS THERE
ANYTHING
WE CAN DO?

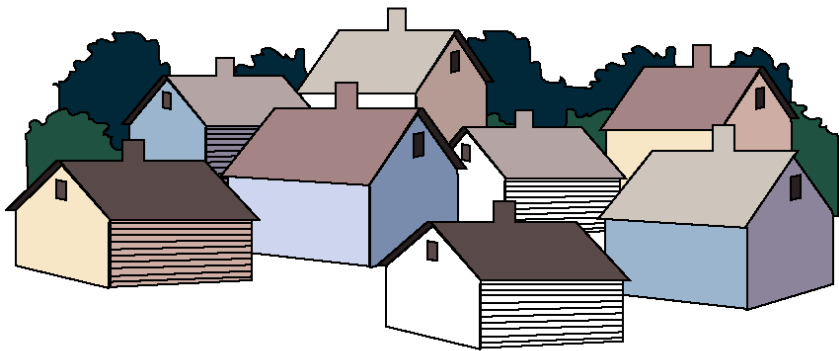
WHERE IS THIS CARBON DIOXIDE COMING FROM?

WE ARE ALL RESPONSIBLE.



Burning a gallon of gasoline in your car puts 5 pounds of carbon in the atmosphere as carbon dioxide (CO_2), and it will stay there for decades — maybe a century!

Other sources are home heating and electric power production.



SOLAR PHOTOVOLTAIC ENERGY

Decrease your carbon legacy by generating your own electricity



Decrease your electric bill, too; maybe even to zero!

ENERGY EFFICIENT CARS

Decrease your carbon legacy by driving an energy efficient car



Decrease your gasoline bill, and drive in HOV lane, too!

Global Atmosphere, Global Warming

QUESTIONS ABOUT GLOBAL WARMING

- IS IT REAL?
- IS IT IMPORTANT?
- WHAT IS IT DUE TO?
- HOW MUCH MORE CAN WE EXPECT?
- ARE WE SEEING JUST THE TIP OF THE ICEBERG?



***BNL RESEARCH IS HELPING
TO ANSWER THESE QUESTIONS.***

THANK YOU

summer  sundays


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